

ELECTRONIC FUNDAMENTALS

EXPERIMENT LESSON 5

CONTINUING THE MULTIMETER ASSEMBLY

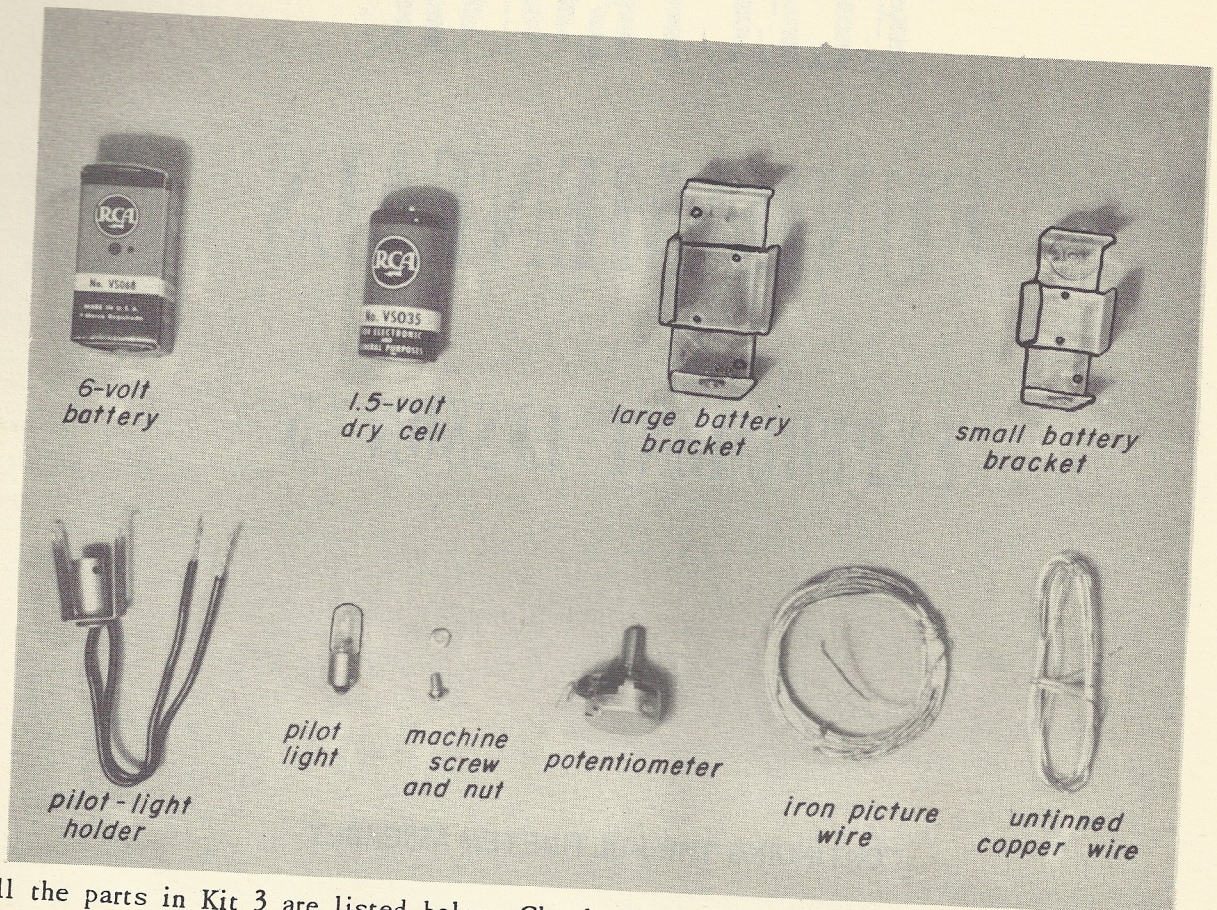


RCA INSTITUTES, INC.

A SERVICE OF RADIO CORPORATION OF AMERICA

HOME STUDY SCHOOL

350 West 4th Street, New York 14, N. Y.



All the parts in Kit 3 are listed below. Check the parts you receive against this list. Make sure you have the correct quantity of every item. If a part is either missing or defective upon arrival, request a replacement from Department R, Home Study School, RCA Institutes, Inc., 350 West 4th Street, New York 14, N.Y. Your request must include your name and student number, the complete name and description of the part copied from the Item column below, the Quantity missing or defective, and the reason you are asking for a new part.

KIT 3

BILL OF MATERIALS

Quantity	Item	Quantity	Item	Quantity	Item
1	Battery, 6 volts	2	Potentiometer, 30 k-ohms, with 1 flat washer and 1 nut	1	Resistor, 15 ohms, $\frac{1}{2}$ watt, 5% <i>Brn Grn Black Gold</i>
1	Dry cell, type C, 1.5 volts	1	Resistor, 110 k-ohms, $\frac{1}{2}$ watt, 5% <i>Brn Brn Yell Gold</i>	1	Resistor, 9.1 ohms, $\frac{1}{2}$ watt, 5% <i>White Brn Gold Gold</i>
3	Dry cell, type D, 1.5 volts	1	Resistor, 22 k-ohms, $\frac{1}{2}$ watt, 5% <i>Red Red Oran Gold</i>	1	Resistor, 1 ohm, $\frac{1}{2}$ watt, 5% <i>Brn Black Gold Gold</i>
1	Pilot light	1	Resistor, 17.9 k-ohms, $\frac{1}{2}$ watt, 1%	2	Machine screws, 6-32 x $\frac{5}{16}$ "
1	Large battery bracket	1	Resistor, 1,500 ohms, $\frac{1}{2}$ watt, 5% <i>Brn Grn Red Gold</i>	2	Hex nuts
1	Small battery bracket	1	Resistor, 91 ohms, $\frac{1}{2}$ watt, 5% <i>White Brn Black Gold</i>	3'	Bare copper wire, solid untinned
1	Pilot-light holder			3'	Iron picture wire, stranded
				5'	Hook-up wire, stranded tinned

If you get a part slightly different from a part described in this list, the substitute part will not interfere electrically or mechanically with your experiments or equipment.

Experiment Lesson 5

OBJECT

To continue the assembly of your multimeter with the parts received in Kit 3.

METHOD

As in Experiment Lesson 3, the wiring you perform in this lesson is planned in a series of steps. By following the instructions and performing the steps in order, you will avoid making errors. Be sure to solder connections when soldering is called for and to make only a simple connection without soldering when so instructed. Before each step, check and double-check the instructions and the picture diagrams so that your multimeter may be wired correctly.

EQUIPMENT NEEDED

Soldering Iron

Cloth for keeping soldering tip clean

Solder

Long-nose pliers

Diagonal cutting pliers

Adjustable crescent wrench, or a one half inch open-end or box wrench

Fine-blade screwdriver

CHECK KIT

Carefully unpack the parts sent to you in Kit 3. Check them against the packing list as directed on page 2.

After checking the parts, place the pilot light, pilot-light socket, and the three 1.5-volt D cells away where you can find them for the next Experiment Lesson.

INFORMATION

Two potentiometers are included in Kit 3 (P_1 and P_2). A complete definition and explanation of *potentiometers* is given in Theory Lesson 7. When you are ready to study Lesson 7, you will be better prepared to understand the differences between resistors, variable resistors, and potentiometers. However, for now, it can be said that a potentiometer is a resistor with a sliding arm, as shown in Fig. 5-1. Both potentiometers are exactly alike, so it does not matter which becomes P_1 and which P_2 . Later in this lesson, you will fasten these two potentiometers back to back. At that time, you will receive instructions for doing so. Where tinned bare wire is called for, use a piece of solid pushback wire, with the insulation removed.

CHECK YOUR WORK

Before you start to work, re-check the wiring and connections made in Experiment Lesson 3. If you haven't looked at these first steps recently, you may now be able to find an error more easily than you could have when you had just completed the work. Remember that no extra care you take now is wasted, because you are laying the foundation for the good workmanship that is expected of successful, reputable radio and television serviceman. When you are sure that no error has been made in the

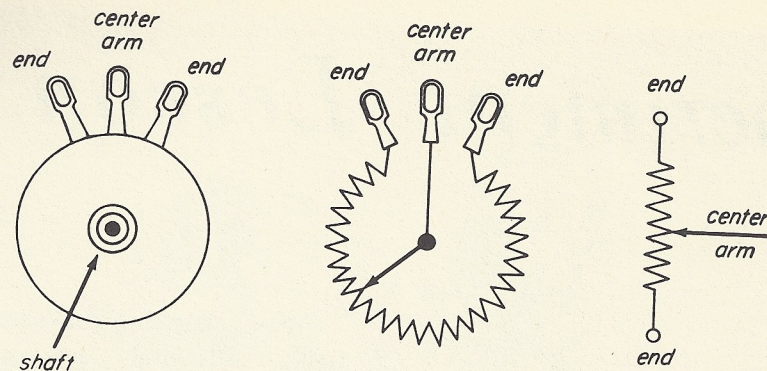


Fig. 5-1

previous work, proceed with the following preparation.

PREPARATION

1. Carefully examine the picture diagrams in Fig. 5-2 and see just where the parts go and how they look when properly wired.
2. Examine the schematic diagram shown in Fig. 5-3 to see the electrical connections to be made in this lesson. You will notice that the work already done is shown by light lines and the work to be done in this lesson is shown by heavy, dark lines. In this way, you can see how the wiring you are now going to do fits in with the wiring completed in Experiment Lesson 3.

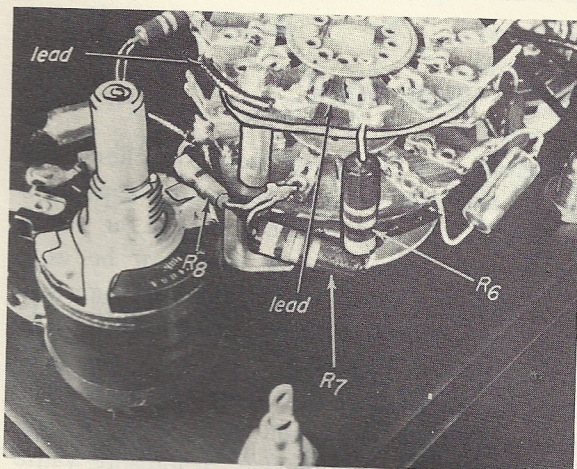
3. Make sure that your soldering iron tip is clean. Then plug in your iron to an electric-power outlet so that it will be ready for use when you need it.

4. Clear your bench or table and arrange your tools for easy use.

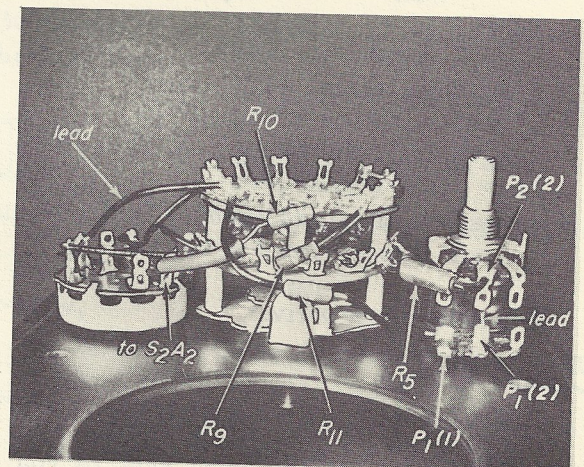
Note: Remember that the instruction to connect means to make a good tight connection, without soldering, and the instruction to solder means to make a good tight connection and then solder.

JOB 5-1

To mount resistor R_6 on RANGE selector switch S_1 .



(a)



(b)

Fig. 5-2

Procedure.

Step 1. Remove 1 inch of lead from each end of the 1-ohm resistor, R_6 .

Step 2. Connect one end of the resistor to S_1B_5 and connect the other end to S_1A_5 (on the deck above).

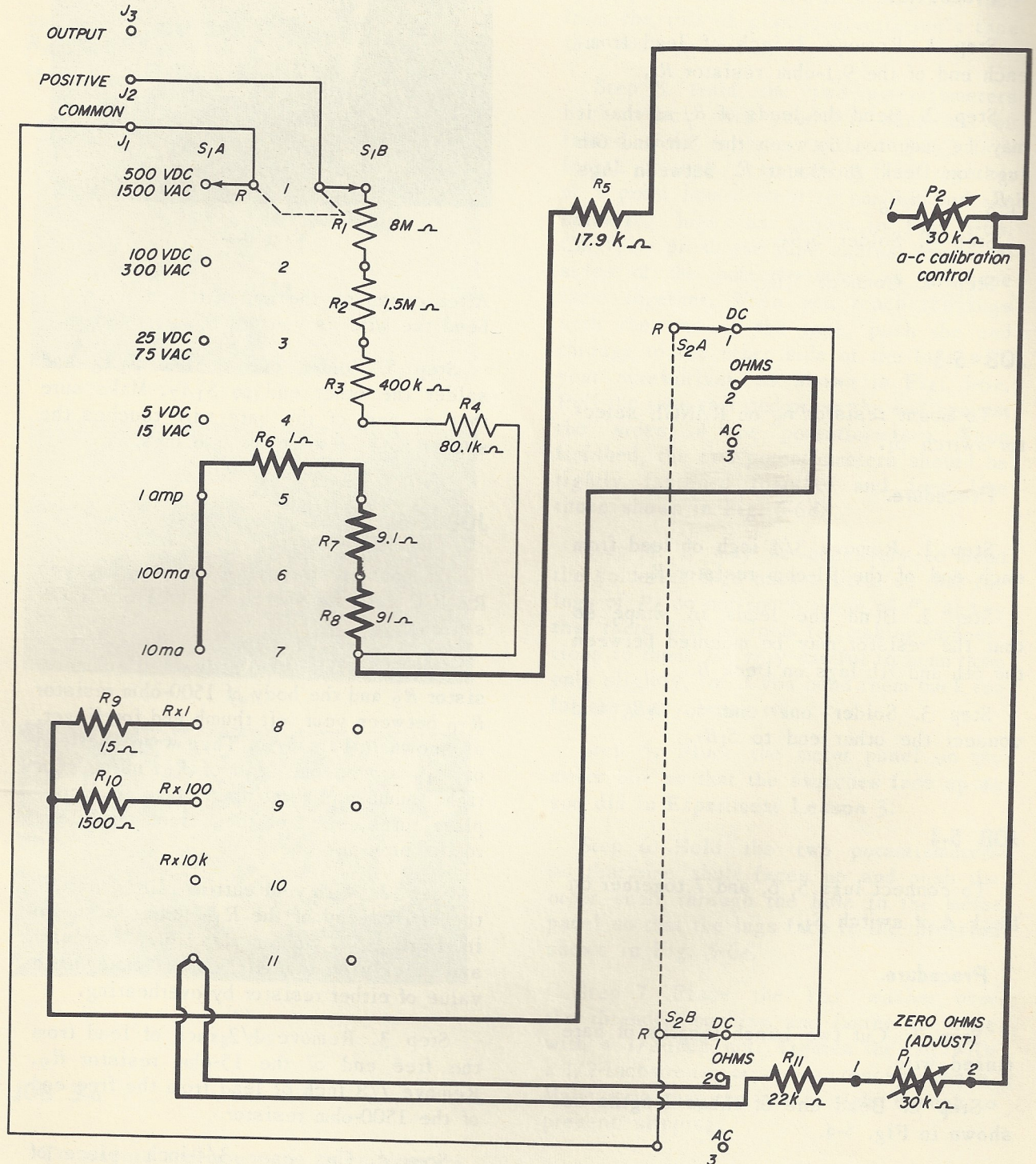


Fig. 5-3

JOB 5-2

To mount resistor R_7 on switch S_1 .

Procedure.

Step 1. Remove 1 inch of lead from each end of the 9.1-ohm resistor R_7 .

Step 2. Bend the leads of R_7 so that it may be mounted between the 5th and 6th lugs on Deck B. Mount R_7 between lugs S_1B_5 and S_1B_6 .

Step 3. Solder S_1B_5 .

Step 4. Connect S_1B_6 .

JOB 5-3

To mount resistor R_8 on RANGE selector switch S_1 .

Procedure.

Step 1. Remove 3/4 inch of lead from each end of the 91-ohm resistor R_8 .

Step 2. Bend the leads in shape so that the resistor may be mounted between the 6th and 7th lugs on Deck B.

Step 3. Solder one end to S_1B_6 and connect the other end to S_1B_7 .

JOB 5-4

To connect lugs 5, 6, and 7 together on Deck A of switch S_1 .

Procedure.

Step 1. Cut two 1-inch lengths of bare tinned wire.

Step 2. Bend one of these lengths as shown in Fig. 5-4.

Step 3. Solder one end of this connector to S_1A_5 . Connect the other end to S_1A_6 .

Step 4. Cut 1/2 inch of spaghetti and slip it over the other 1-inch piece of wire.

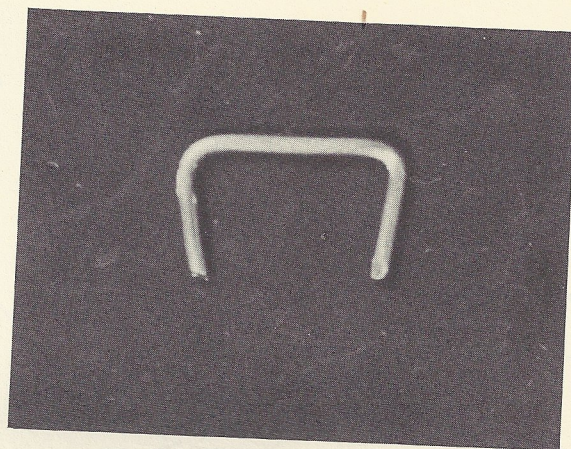


Fig. 5-4

After centering the spaghetti on the wire, bend the wire as you did the first length.

Step 5. Solder one end to S_1A_6 and solder the other end to S_1A_7 . Make sure that no part of the bare wire touches the spacer post between the two lugs.

JOB 5-5

To mount resistors R_9 and R_{10} between RANGE selector switch S_1 and FUNCTION switch S_2 .

Step 1. Grasp the body of 15-ohm resistor R_9 and the body of 1500-ohm resistor R_{10} between your left thumb and forefinger, as shown in Fig. 5-5a. Then wrap one lead of R_{10} around one lead of R_9 , using your right thumb and forefinger. Make four complete turns, each of them tight and close to the previous one.

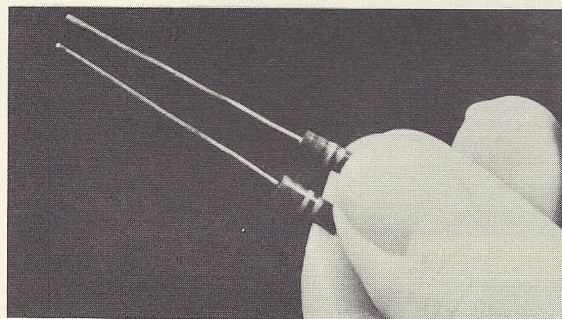
Step 2. With your cutting pliers, remove the unused end of the R_{10} lead, as shown in Fig. 5-5b. Solder this joint carefully and quickly so that you do not change the value of either resistor by overheating.

Step 3. Remove 1/2 inch of lead from the free end of the 15-ohm resistor R_9 . Remove 7/8 inch of lead from the free end of the 1500-ohm resistor.

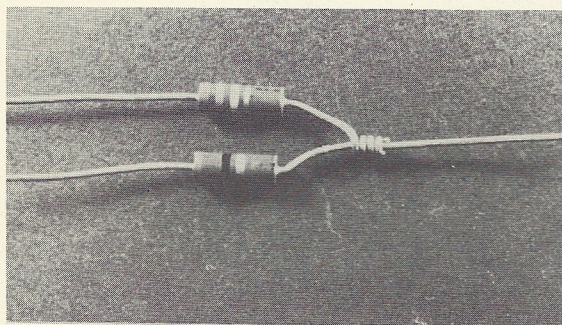
Step 4. Cut one 3/4-inch piece of spaghetti and slip it over the free end of resistor R_9 . Slip this end into the lug of S_1A_8 . At the same time, slip the free end of R_{10} into S_1A_9 . When you have made a

good tight connection to each of these lugs, solder R_9 to S_{1A8} and R_{10} to S_{1A9} as shown in Figure 5-5c.

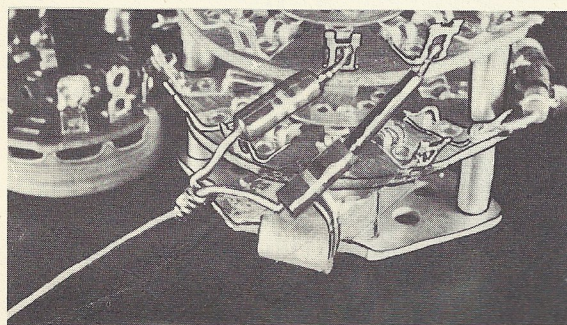
Step 5. Cut one 1-1/4-inch length of spaghetti and slip it over the joint lead of R_9 and R_{10} . Connect (but do not solder) this lead to S_{2A2} .



(a)



(b)



(c)

Fig. 5-5

JOB 5-6

To prepare and mount the potentiometers P_1 and P_2 on the meter panel.

Procedure.

Step 1. Place the two potentiometers,

P_1 and P_2 , back-to-back, as shown in Fig. 5-6a. See that the lugs of each potentiometer are located as shown.

Step 2. Cut a 3-1/2 inch length of tape from the roll of plastic electrician's tape that you received in Kit 1.

Step 3. Hold the two potentiometers back-to-back with your left hand as you fasten them together with a 3-1/2 inch length of tape. Start taping them together at a point immediately to one side of the soldering lugs, as shown in Fig. 5-6b. Carefully press the tape against the metal sides of the potentiometers as you tape them together. When you reach the lugs with the end of the tape, push the end through to the other side of the lugs with your screwdriver, as shown in Fig. 5-6c. Pull the tape taut and press the end against the sides of the potentiometers. When finished, the two potentiometers should be tightly fastened together and look like those shown in Fig. 5-6d.

Step 4. It may be necessary to bend the soldering lugs back a little so that the lugs of P_1 do not touch those of P_2 and so that there will be room for making connections to them. Be very careful to bend them only slightly, for if you bend them back too far they may break off.

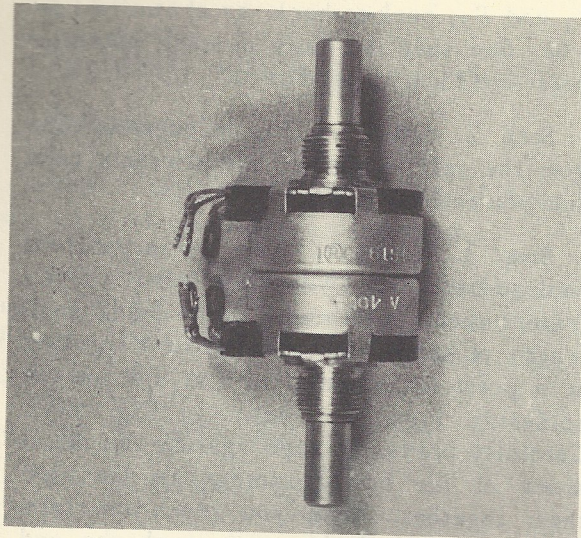
Step 5. Place the meter panel on the meter box so that the switches face up as you did in Experiment Lesson 3.

Step 6. Hold the two potentiometers so that one shaft faces up and push the other shaft through the hole in the meter panel so that the lugs face in the direction shown in Fig. 5-6e.

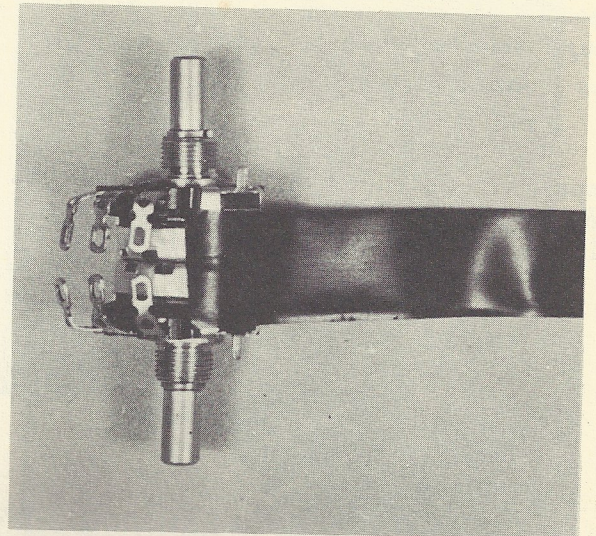
Step 7. Place the flat washer over the threaded bushing and fasten in place with a 1/2-inch nut. Tighten the nut with a 1/2-inch wrench or with a crescent wrench. Make sure that the nut is tight enough to prevent slipping.

JOB 5-7

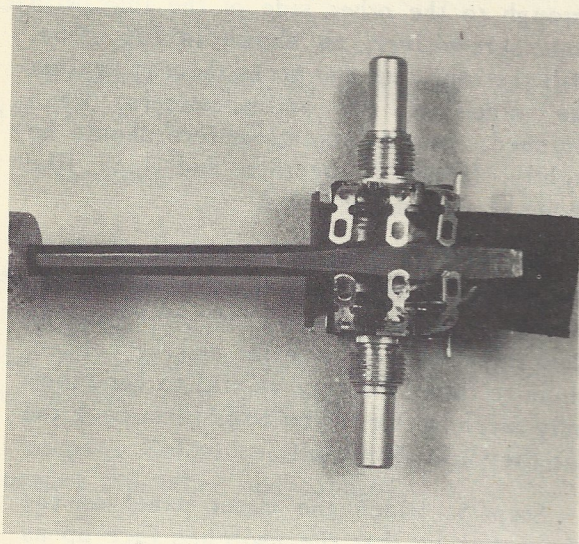
To mount resistor R_{11} between potentiometer P_1 and switch S_1 , as shown in Fig. 5-7.



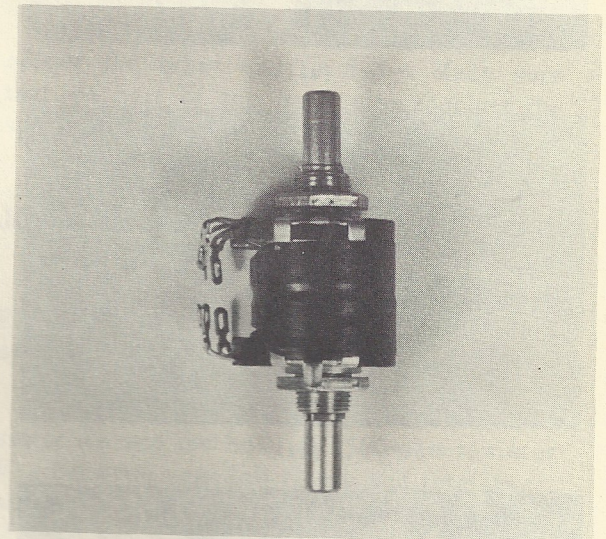
(a)



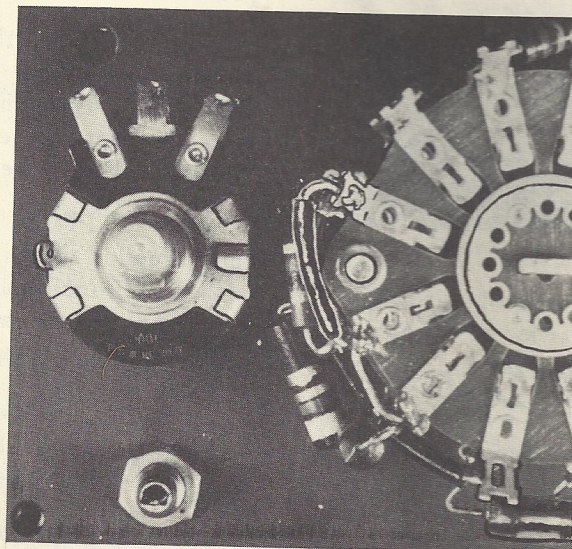
(b)



(c)



(d)



(e)

Fig. 5-6

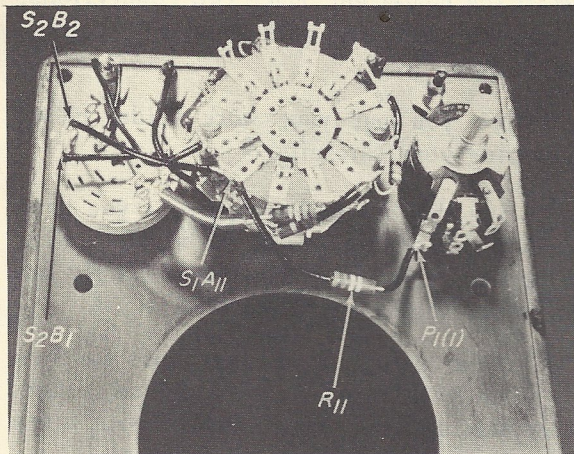


Fig. 5-7

Procedure.

Step 1. Cut two 1-1/4-inch lengths of spaghetti. Slip one length over each end of the 22 k-ohm resistor R_{11} .

Step 2. Solder one end of R_{11} to terminal 1 of potentiometer P_1 . Connect the other end to S_1A_{11} , as shown in Fig. 5-7.

Because the adjustable stop was placed on the RANGE selector switch S_1 so that only the first ten positions can be used, terminals S_1A_{11} and S_1B_{11} are not used as part of switch S_1 . Therefore, in connecting one end of resistor R_{11} to S_1A_{11} , you are making use of the lug as a convenient place to tie two circuits together. The leads of resistor R_{11} are not long enough to reach all the way from potentiometer P_1 to FUNCTION switch S_2 . So lug 11 on Deck A comes in handy, because, to complete the circuit, you now can connect a wire lead between this lug and switch S_2 .

JOB 5-8

To connect S_1A_{11} to S_2B_2 .

Procedure.

Step 1. Cut one 2-1/2 inch length of hook-up wire. Remove 1/4 inch of insulation from each end.

Step 2. Solder one end of this lead to S_1A_{11} and solder the other end to S_2B_2 , as shown in Fig. 5-7.

JOB 5-9

To mount R_5 between RANGE selector switch S_1 and potentiometer P_2 .

Procedure.

Step 1. Remove 3/4-inch of lead from each end of the 17.9 k-ohm resistor R_5 .

Step 2. Cut two 1/2-inch lengths of spaghetti. Slip one length over each end of resistor R_5 .

Step 3. Connect one end of this resistor to terminal 2 of potentiometer P_2 , as shown in Fig. 5-8.

Step 4. Solder the other end of this resistor to S_1B_7 .

JOB 5-10

To make a connection between potentiometer P_1 and potentiometer P_2 .

Step 1. Cut 1 inch of bare tinned wire.

Step 2. Connect one end of this lead to terminal 2 of potentiometer P_2 , as shown in Fig. 5-9.

Step 3. Solder the other end of the lead to terminal 2 of potentiometer P_1 .

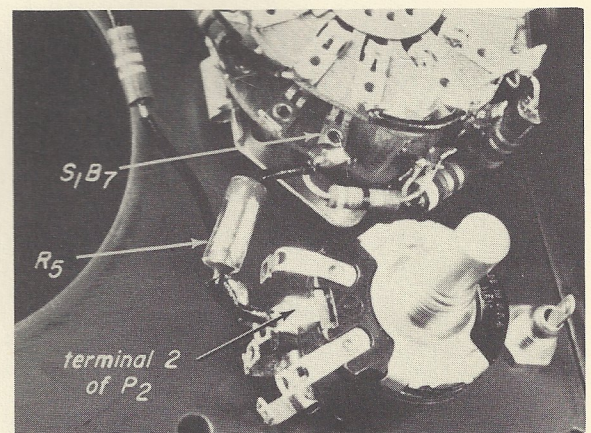


Fig. 5-8

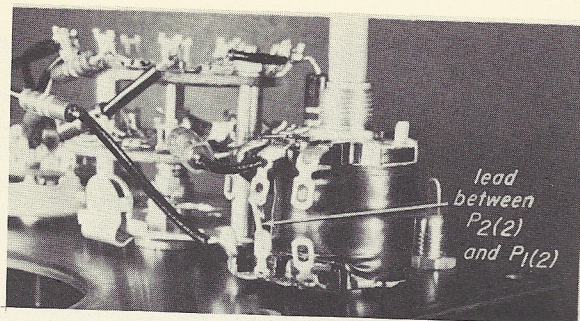


Fig. 5-9

CHECK YOUR WORK

With the connection made in Step 3 of Job 5-10, your multimeter is ready for the installation of the meter movement that will be sent to you in Kit 4. As soon as you are ready for Experiment Lesson 7, you can

install the movement, make two connections, and put the meter to work measuring voltage and current.

Before you put your work aside, check the wiring very carefully.

1. See that the seven resistors you have wired in this lesson are of the values called for and that they are connected exactly according to the instructions.

2. Make sure that no bare wire touches any other bare wire or metal surface, except where instructions call for two or more wires to be connected to the same terminal.

3. Check the soldering; see that it is well done, with no excess solder or cold-soldered joints. Be very sure that no bits of solder dropped among the switch contacts while you were soldering.

